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ABSTRACT

Nineteen projects related to mathematics education issues among minorities, funded by the Learning and Development Unit at the National Institute of Education (NIE), are summarized. It is felt that minorities and mathematics education issues have been largely neglected in recent investigations. This neglect is seen to have the potential to render tenuous the generalizability of empirical findings which have been observed among the non-minority student population. The studies abstracted here cover seven ethnic groups, with both sexes included. Collectively, they include populations in all levels of schooling. More specifically, two investigations include pre-elementary school populations, six involve grades K-6, six focus on grades 7-9, four on grades 10-12, seven include college populations, and five involve adult professionals. Further, three studies do not specify what ethnic groups are included. Of the remaining, eight involve whites, seven pertain to blacks, and four include Puerto Ricans. Each of the groups American Indians, Chinese, and Chicanos is included in two studies, and one report includes Alaskan Natives. One study covers females only, the remaining include both sexes. (MP)

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A Synthesis of Selected Research at NIE in Mathematics Education Related to Minorities

by

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Abstract

Purpose: The purpose of this synthesis is to summarize nineteen projects related to mathematics education issues among minorities funded by the Learning and Development Unit at NIE.

Population: The student populations included in the investigations range from pre-elementary level to college and out-of-school professionals.

Males and females are represented in the samples, and at least seven different ethnic populations.

Procedures and Analysis: Some studies plan to analyze the data using only quantitative techniques while others plan to use only qualitative analysis. The remaining use a combination of both.

Expected Results: Five of the projects expect to contribute to the design and development of effective intervention programs aimed at increasing the representation of minorities in mathematics related fields.

Eleven studies project to contribute to a better understanding of basic knowledge in the areas of mathematics learning and cognitive processes and development among minorities.

One study focuses in contributing to the improvement of mathematics and science teaching for minorities.

The remaining two projects expect to make contributions to basic research and teaching.

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Introduction

A result of the proliferation of mathematics education research during the last two decades has been the exploration of exciting frontiers of knowledge previously neglected in other disciplines. One area that remains largely neglected, however, concerns minorities and mathematics education issues. This neglect has the potential to render tenuous the generalizability of empirical findings which have been observed among the non-minority student population. For instance, Meyer (1981) reports that the model of Figure Matrix, Number Exclusion, and Mathematics Computation was more effective in discriminating the good and poor problem solvers than any other reduced model. Can this same model discriminate good and poor problem solvers in minority populations? Perhaps; perhaps not. Many more parallel questions can be posed pertaining to other areas in mathematics education which illustrate the general point of this paragraph.

The latter part of the decade of the 70's witnessed an interest in increasing the representation of minorities in mathematics related fields by some federal agencies and professional organizations. The National Science Foundation (NSF) funded several resource centers for science and engineering specifically to achieve this end. Also, the National Institute of Education (NIE) has funded several research projects addressing the general theme of minorities and mathematics education questions. The purpose of this article is to synthesize a selected number of such studies funded by NIE through the Learning and Development Unit of the Teaching and Learning Program. The following pages summarize the studies and the summary is broken down into five broad headings: population, purpose, procedures, and analysis, expected outcomes, and preliminary findings.

The summary is followed by abstracts of the studies.

The Studies

Population

The studies collectively include populations in all levels of schooling: pre-elementary to college, and beyond (out-of-school professionals). Seven ethnic groups and both sexes are included. Some studies include more than one ethnic group and more than one level of schooling thus sometimes it appears that the total number of studies is more than nineteen.

More specifically, two studies include pre-elementary school populations, six involve grades K-6, six focus on grades 7-9, four on grades 10-12, seven include college populations, and, finally, five involve adult professionals.

Three studies do not specify what ethnic groups are included, eight involve white populations, seven address issues pertaining to blacks, four include Puerto Ricans, each of the groups American Indians, Chinese, and Chicanos is included in two studies, and one study includes Alaskan Natives.

One study includes only females and the remaining eighteen include both sexes.

Purpose

The intended purposes of the studies can be categorized as addressing internal or external variables with respect to the participating populations. Several of the studies address both internal and external variables. The respective definition of internal and external variables as used here is as follows.

Internal variables refer to those aspects that reside within a person such as psychological factors, mental characteristics or processes, attitudes, cognitive development and the like.

External variables refer to those aspects that originate or reside outside a person such as school personnel, school curriculum, parents, peers, and other social influences.

Based on these definitions, ten studies address internal variables, four address external variables, and the remaining five address a combination of internal and external variables.

Procedures and Analysis

There are several studies which limit themselves to the collection of information through interviews and do not specify a quantitative analysis technique for data interpretation. This is an example of a strictly qualitative analysis. On the other hand, some studies limit themselves to quantitative analysis. The remaining projects use a combination of both types of analysis.

In a nutshell, seven studies use primarily qualitative analysis, five will interpret the data quantitatively, and seven use a combination of both techniques.

Expected Outcomes

Just as the purposes of the studies are varied so are the expected results. Five studies expect to contribute to the improvement of intervention programs designed to increase the representation of minorities in mathematics and science related careers. Eight projects envision to contribute to basic research (problem-solving processes, cognitive development, etc.); one study is designed to contribute to the improvement of the teaching of mathematics and science for minority students. Finally, five studies expect to make contributions to both basic research and to teaching.

Preliminary Findings

Although all of the studies have reported progress towards accomplishing their stated purposes, some have provided enough details in their progress reports to make it possible to mention the most salient of their preliminary findings.

Gerace and Mestre report that the performance of college bilingual students on mathematical skills is more strongly related to language proficiency than that of monolinguals. College bilingual students are more propense to be affected by certain kinds of errors that derive from problem wording in mathematical translation tasks. Lastly, the misconceptions about the physical world are not different between bilingual and monolingual college students.

MacCorquodale has observed that minority students need better preparation in basic skills and that Chicano students have high aspirations, believe school is important, and work hard at school. She has also observed that Chicanos are more

strongly influenced by affective factors, and Anglos by job-related factors. Another observation is that Chicanos receive lower grades in science even though they report higher grades and devoting more effort to mathematics than their white counterparts. It remains to be investigated, however, whether Chicanos get lower grades in science because they do lesser quality work or because teachers tend to undergrade them.

MacCorquodale also reports that women and minorities in her sample tend to discontinue enrolling in science courses at the ninth grade.

Stahl and Turner administered a questionnaire to fifty high school and college black women asking questions regarding their career plans and self-perceptions in science. The women surveyed indicated that they intend to pursue their careers, marry and have children; and that their family and friends are supportive of their plans. They also attribute their success in science courses to hard work, perseverance, and determination when answering an open-ended question but to intelligence when answering a multiple choice question.

It is hoped that the final reports will reveal interesting findings essential in furthering our knowledge about crucial factors in the learning of mathematics among minorities.

An annotated list of the projects under discussion follows. The project are listed by alphabetical order of the leading investigators.

Callahan, Leroy G. School Arithmetic Development: Movement Toward Conceptual Maturity of Students with Different Number Abilities on Entering First Grade. Christopher Baldy Hall, SUNY at Buffalo, Amherst, NY. NIE-G-80-0097 Ending date: June 1982.

Purpose: To describe the movement toward conceptual maturity on arithmetic tasks of children.

Population: 90 male and female black and white first grade students representing three levels of proficiency on number tasks: high, medium, and low.

Procedures: Structured interview protocols will be administered individually over two years.

Expected Results: (1) contribute insights into understanding of relationship between early number performance and school arithmetic development; (2) assist urban schools in assessing appropriateness of match between student arithmetic development and school program experiences; (3) assist urban schools in developing procedures in early identification of students with high risk of failure, and high degree of potential in mathematics learning.

Cooper, Robert G., Jr. Consistency and Variation Among Individual Patterns in Preschool Number Development: A Longitudinal Study of Home, School, Sex, and Socioeconomic Factors. Psychology Department, University of Texas, Austin, TX. NIE-G-80-0143. Ending date: August 1982.

Purpose: To study the development of counting, subitizing (directly perceiving numerosity for small quantities), addition/subtraction, and conservation in children.

Population: 640 Black, Chicano, and Anglo children divided equally among 3, 4, 5, and 6 year-olds. Half of the children will be from middle-income and the other half from low-income families.

Procedure:: Two longitudinal studies, one counting and subitizing, the other conservation and addition/subtraction. Children will be assessed individually in sessions six months apart. The respective parents and teachers will be interviewed concerning attitudes, goals, activities, and effectiveness in teaching number concepts.

Scalograms, ANOVA, regression and correlation will be used to discern individual patterns and predictors of patterns and rate of development.

Expected Results: To help clarify how children's difficulties in mathematics depend on particular concepts rather than on general developmental lags or lack of aptitude.

Curcio, Frances R. The Effect of Reading and Math Achievement, Racial Status, Sex and Prior Knowledge on Comprehending Mathematical Relationship Expressed in Graphs. Department of Education, St. Francis College, Brooklyn, NY. NIE-G-80-0093. Ending date: April 1981

Purpose: To extend the schema-theoretic perspective of understanding general discourse to graph comprehension by investigating the effects of prior knowledge on students' ability to comprehend the mathematical relationships expressed in graphs, and whether this effect is over and beyond that of reading performance and mathematics achievement. Sex and racial status differences will be focused on.

Population: 200 fourth-grade boys and girls, and 200 seventh-grade boys and girls in Brooklyn, NY., from different ethnic backgrounds.

Procedures: The California Achievement Test, Reading and Mathematics, a specially designed graph reading test, and three prior knowledge inventories will be administered to the students. Results will be analyzed by multiple regression techniques.

Expected Results: To identify sex and racial differences in graph reading, extend the schema-theoretic perspective of understanding general discourse to graph comprehension and contribute to teachers' awareness about and reasons for diagnosing prior knowledge deficiencies which may impede comprehending the mathematical relationships expressed in graphs.

Gaston, Jerry. Factors Inhibiting Science Careers for Black Women. Department of Sociology, Southern Illinois University, Carbondale, IL. NIE-G-78-0139. Ending date: December 1979.

Purpose: To explore various types of information about the social processes that inhibit black women from entering science.

Population: Black Women from high school through professional level.

Procedures: Collect data from the target population regarding how black women in science have made it and how they compare with other categories of black women.

Expected Results: To produce information leading to the development of a proposal to study the question at a national level and assist in correcting the existing imbalance in science careers.

Gerace, William J., & Mestre, Jose P. Identifying Learning Handicaps of College-Age Spanish-Speaking Bilingual Students Majoring in Technical Subjects. Department of Physics, University of Massachusetts, Amherst, MA. NIE-G-79-0094. Ending date: August 1982.

Purpose: To answer the general question of whether college Spanish-Speaking bilinguals majoring in technical subjects encounter any unique difficulties by investigating the following specific questions:

1) What are a bilingual student's preconceptions and misconceptions before, during, and after taking a technical course, and are they different from those of a monolingual student? 2) Do bilingual students retain misconceptions formed in one language that have been resolved in the other language? 3) Is a bilingual's problem-solving ability regarding speed and accuracy dependent upon the language in which the information needed to solve the problem was learned? 4) In testing situations on technical subjects, what are likely to be the stumbling blocks of bilingual students due to subtle language misunderstandings? and 5) Are the difficulties encountered by a bilingual in developing problem-solving skills, different from, or similar to, his/her monolingual counterpart?

Population: Spanish-Speaking bilingual undergraduate students majoring in science, mathematics, and engineering.

Procedures: Written exams will be administered to monolingual and bilingual students and they will be asked to think aloud through verbal problems in a science context. The protocols will be videotaped for later scrutiny.

Expected Results: To identify the common stumbling blocks of the target population and thus be in a position of helping them become better learners.

Preliminary Findings: (1) the performance of college bilingual students on math skills is more strongly correlated with language proficiency than that of monolinguals. (2) college Bilingual students perform mathematics tasks at a slower pace than monolinguals. (3) college Bilingual students are more susceptible than monolinguals to certain kinds of errors that derive from problem wording in mathematical translation tasks. (4) the misconceptions about the physical world are not different between bilingual and monlingual college students.

Gerace, William J., & Mestre, Jose P. A Study of Cognitive Development of Hispanic Adolescents Learning Algebra Using Clinical Interview Techniques. Department of Physics, University of Massachusetts, Amherst, MA. NIE-R-400-81-0027 Ending Date: November 1982.

Purpose: To investigate the cognitive processes of Hispanic bilingual students learning Algebra I.

Population: Ten Spanish-Speaking bilingual ninth grade students.

Procedures: Students will be interviewed monthly to catalogue their error patterns and successful strategies in their learning of algebra. Background questionnaires will be administered to both parents and students to ascertain their SES level, academic achievement, and attitudes towards education and mathematics. The analysis of the data will be both quantitative and qualitative.

Expected Results: Findings should aid in designing math curricula for bilingual students, and in helping bilingual students become better learners by making them aware of successful strategies as well as common avoidable errors.

Johnson, Robert C. Psychosocial Factors Affecting the Mathematical Orientation of Black Americans. Institute of Black Studies, Inc. St. Louis, Mo. NIE-G-79-0093. Ending date: May 31, 1981

Purpose: To identify those personal, family, and situational differences between blacks who demonstrate an aptitude or orientation for mathematics and those who do not.

Population: Two hundred black males and females ranging in age from early adolescence to adulthood. Half the sample will be "mathematically oriented" and the other half will not be "mathematically oriented."

Procedure: The participants will be interviewed and asked to complete a questionnaire and a values inventory.

Expected Results: (1) to suggest strategies, policies, and programmatic actions needed to improve opportunities for blacks in scientific and technical fields, especially at the pre-college level.

(2) to suggest crucial time periods in developing minorities for math-related occupations.

(3) to ascertain when decisions are made by blacks to pursue certain career options and when to select mathematics courses along with the variable influencing such decisions.

(4) to suggest areas in which intervention efforts need to be targeted and new research directions.

Preliminary Findings: (1) difficulties have being faced by project staff to overcome hesitations of junior high students to be interviewed.

(2) new data gathering techniques have been deviced to collect attitudinal data from junior high students.

Leap, William L. Dimensions of Math Avoidance Among American Indian Elementary School Students. Department of Anthropology, American University, Washington, D.C. NIE-G-79-0086. Ending Date: August 1980.

Purpose: to explore and identify those aspects of "math avoidance" which create and maintain barriers to mathematics achievement among American Indian students.

Population: Third graders.

Procedure: Classroom-based field study using a coding system to analyze transcripts of instruction on a series of mathematical topics, teacher-student observations, and field-interviews with school teachers and officials. The data will be analyzed cross-culturally.

Expected Results: (1) identify critical variables which act as barriers to Indian students' mathematics learning.

(2) advance suggestions for possible improvements in teaching strategies and theoretical approaches for instructing American Indian children in mathematics.

MacCorquodale, Patricia. Social Influences on the Participation of Mexican-American Women in Science. Department of Sociology, University of Arizona, Tucson, AZ. NIE-G-79-0111. Ending date: September 1981.

Purpose: to examine the social factors which hinder or facilitate the participation of female Mexican Americans in science courses and careers

Population: Mexican American and Anglo junior high and high school students of both sexes from Nogales and Tucson, AZ.

Procedure: administer questionnaires and interviews to students, teache counselors, and parents to determine (1) educational and occupational aspirations; (2) students' attitudes toward school subjects, including perceived usefulness of subject, motivation to learn the subject and perceived ability; (3) attitudes toward women with respect to occupation roles; (4) self-image; (5) support and encouragement from parents, teachers, and friends; and (6) family background characteristics.

Projected Findings: (1) information on social factors that influence educational and occupational aspirations.

(2) compare the effect of attitudes, self-image, and family background to the effect of encouragement and support from teachers, parents, and friends.

Preliminary Findings: (1) minority students need better preparation in basic skills, Chicanos have high aspirations, believe school is important, and work hard in school.

(2) minority students need to be encouraged to take math and science courses to enhance their educational and occupatio options.

(3) sextyping of math careers needs to be addresse

(4) minority students need more career counseling

(5) minority parents do support and encourage the children's education.

(6) Anglo males are the most interested in career sciences and are more likely to take courses in science.

(7) the attrition of women and minorities from science begins at the ninth grade.

(8) the more students like science, care about doing well in science, and see sciences as related to their jobs and lif the more interested they are in taking science. Chicanos are more strongly influenced by affective factors, and Anglos by job related fact

(9) Chicanos receive lower grades in science but report higher grades and devoting more effort to math.

Marrett, Cora B. Minority Female Involvement in High School Science and Mathematics. Departments of Afro-American Studies and Sociology, University of Wisconsin, Madison, WI. NIE-G-79-0110. Ending date: June 1981.

Purpose: to help extend to black females the career options by investigating the school-related characteristics and processes which could enhance their participation in scientific and technical fields.

Population: High school personnel, teachers and counselors.

Procedures: Administer surveys to delineate the school organizational characteristics and the background and attitudinal traits of school personnel which seem to contribute to the involvement and participation of black females in non-required mathematics and science courses and curricula and extra-curricula science activities.

Expected Results: to generate information pertinent to extending employment opportunities in science related careers to black women.

Moore, Charles G. Language and Cultural Determinants to Mastery of Mathematics Concepts by Undergraduate Native American College Students. Department of Mathematics, Northern Arizona University, Flagstaff, AZ. NIE-G-80-0100. Ending date: September 1981.

Purpose: To attempt to identify those elements in the language or cultural background of Native American undergraduates that may inhibit their effective learning of mathematics concepts.

Population: Native American undergraduates enrolled in one or more mathematics courses, Native American educators, linguists and anthropologists who have studied in the target communities, Navajo and Hopi.

Procedures: Interviews with the above populations.

Expected Results: The identification of the barriers to learning mathematics may result in a diminution of anxiety and frustration which contribute to a high rate of failure, and generate hypotheses for further research.

Morse, Linda W. Relationship of Significant Others, Parental and Teacher Influences to the Development of Self-Concept, Science Attitudes and Achievement Among Adolescent Girls. Bureau of Education Research and Development, Mississippi State University, MS. NIE-G-79-0159. Ending date: September 1981.

Purpose: To examine the relationship of students' attitude toward science, and their achievement in science, self-concept and perception of their sex roles.

Population: Black and white students of both sexes 12-16 years of age in grades 7-9.

Procedures: Longitudinal data collection measuring students' attitude toward science, achievement, self-concept, sex-role concept, influence of significant others, social status, and classroom interactions with teachers and peers.

Expected Results: The data will show differential treatment for males and females in science classes by teachers and peers which will be reflected in an increasing differential self-concepts; achievement and attitudes toward science as the students

progress through junior high school.

Orvik, James. The Social Basis of Mathematics Teaching and Learning. Center for Cross-Cultural Studies, University of Alaska, Fairbanks, AK. NIE-G-80-0092. Ending date: June 1981.

Purpose: To begin an interdisciplinary research effort into the nature of mathematics teaching and learning across cultures leading to the generation of hypotheses about (1) the cognitive characteristics of learners and teachers; (2) the nature of mathematical tasks; and (3) teacher/learner social interaction in cross-cultural situations.

Population: Collaboration between teachers, mathematicians, educational researchers, and minority group pupil to raise questions and hypotheses.

Procedures: Data collection through ethnographic methods, video tape analysis, and field notes in three phases: (1) establishment of initial data base; (2) interactive analysis and review of data base; and (3) analysis and synthesis of the data base and interaction.

Expected Results: To identify educational and social processes best suited to increase the integration of mathematical thinking into the social and cultural circumstances of the learner and thus respond to the need to increase the participation of minority group members in science and technology through improved mathematics instruction.

Parelius, Ann P. Determinants of Gender Differences in Course Enrollment and Goals in Mathematics, Science, and Engineering Among Black and White College Students. Department of Sociology and Anthropology, Rutgers College, Rutgers University, New Brunswick, N.J. NIE-G-79-1410. Ending date: August 1981.

Purpose: To assess the impact of various social processes on the enrollment of male and female college students in mathematics related courses, their choice of major, and their educational and career aspirations.

Population: 1,500 black and white female college freshmen and sophomore students.

Procedure: Questionnaires to be administered at six different times to the participating subjects and analyzed through linear regression models, discriminant analysis, and path analysis in a longitudinal design.

Expected Results: To discover the patterns of interaction among students' individual characteristics, interpersonal experiences, and learning environments contributing to the differential representation of these populations in mathematics related careers. Such information can point the elements that can be modified to channel more white and black women into nontraditional training and career choices.

Saxe, Geoffrey B. A Development Analysis of Numeration Concepts: The Effects of Language Background, Mother-Child Interaction, and Metacognitive Processes. The Graduate Center, City University of New York, New York, NY. NIE-G-80-0119. Ending date: September 1983.

Purpose: To study how the development of numerational concepts in children is affected by differences in both language background and the style of mother-child interaction in problem solving settings.

Population: Monolingual and Bilingual in Spanish/English, and Chinese/English, middle and lower class children from 3-14 years of age (pre-school through eighth grade).

Procedures: Nine studies will be conducted. Studies 1-5 will include bilingual inner city Hispanic and Chinese children from 5-14 years of age exploring the question whether middle class bilingual children show an advantage over their monolingual counterparts in numeration. Study 6 will investigate how mother-child interactions facilitate the use of counting in problem solving activities and how these interactions differ over social class. Subjects will be mothers and their 3-or-4-year old children from middle and low SES backgrounds. Studies 7-9 will analyse children's ability to monitor their own counting accuracy in problem solving situations. Children will be from middle and low SES backgrounds 5-9-years old.

Expected Results: (1) to provide information about the development of numeration concepts from pre-school through eighth grade.

(2) to reveal special competencies of inner city bilingual children.

(3) to illuminate early sources of differences in levels of preparedness of children to engage in math learning.

(4) to reveal areas in which children have difficulty in early forms of computation and how to improve these skills.

Schwartz, Judah L. The Role of Semantic Understanding in Solving Multiplication and Division Word Problems. Division for Study and Research in Education, Cambridge, MA. NIE-G-80-144. Ending date: August 1981.

Purpose: To extend the study of the difficulties children have with intensive quantity in multiplication and division and to examine children's solving of Cartesian product and related rate problems.

Population: Four groups of twenty-four children each consisting of

(1) middle class urban Puerto Rican children in Puerto Rico
(2) low-income urban Puerto Rican children in Puerto Rico
(3) Puerto Rican migrants in the U.S. and
(4) U.S. urban middle class children.

All children between the age of 9-13 years.

Procedures: The task will be presented to each child individually and it will consist of two parts: the children will solve a total of six problems; and they will make drawings of the situations described in the problems.

The session will be in the language of the child and it will be audio-taped.

Expected Results: 1. To contribute to the understanding of the cognitive components needed in the understanding of different type of problems.

2. To develop, refine, and validate a taxonomy of word problems which will uncover the interrelationship between different types of problems at the same time that it will distinguish among them.

Stahl, Jeanne M., & Turner, Henrie M. Factors Influencing Persistence and Achievement in the Sciences and Health Professions by Black High School and College Women. Department of Education and Psychology, Norris Brown College, Atlanta, GA. NIE-G-79-0116. Ending date: August 1982.

Purpose: To determine three categories of factors which influence persistence and achievement in the sciences and health professions by black women in high school and college: (1) characteristics of black and white high school and college men and women in the Southeast; (2) Existing and expected social forces operating to encourage or discourage persistence and achievement; and (3) Internalized social forces and self-concepts which operate to encourage or discourage persistence and achievement.

Population: About 2,000 men and women in their senior year of high school through senior year in college.

Procedures: Cross-sectional and longitudinal survey data from subjects of both sexes will be analyzed by correlation and multiple regression analysis.

Expected Results: Findings will serve as a base for the development of counseling and group therapy techniques to encourage black women to pursue science and view themselves as achievers and to welcome challenge and success rather than to flee from it.

Preliminary Findings: A sample of fifty black high school science and college black women attending a women in science workshop were administered a questionnaire asking questions regarding: (1) expectations concerning career and motherhood; (2) expectations and support of family and friends; (3) fear of success; (4) "Imposter phenomenon" e.g., attributing one's success to hard work, perseverance, or determination rather than intelligence.

Subjects were high achievers by academic standards, middle class of professional parents.

The survey revealed that these black women:

plan to marry, have children, and pursue their careers;

family and friends are supportive of their plans to continue career;

show little indication for fear of success;

they attribute their success to hard work, perservance, or determination

when answering an open ended question but to intelligence when multiple choices are given.

Tsang, Sau-Lim. Mathematics Learning Styles of Chinese Immigrant Students. ARC Associates, Inc. 310 Eighth Street, Suite 200; Oakland, CA 94607. NIE-R-400-81-0026 Ending date: November 1982.

Purpose: To investigate the difficulties that minority students have in learning Algebra I.

Population: Twelve Chinese students enrolled in Algebra I at Mission High School in San Francisco, CA. who have just arrived to the United States.

Procedures: Classroom observations, and teacher and student interviews will be conducted. This together with students' classwork and homework will be the sources of data. The data collected pertaining to students will be analyzed using a 3x2x2 factorial design.

Expected Results: It is expected that the investigation will result in improved knowledge about how students learn and conceptualize algebraic principles and concepts. This in turn will be useful in improving the mathematics curriculum and teaching.

Wagner, Sigrid. A Clinical Investigation of Learning Difficulties in Elementary Algebra. Mathematics Education Department, 105 Aderhold Hall, University of Georgia, Athens, GA. 30602. NIE-R-400-81-0028 Ending date: November 1982.

Purpose: To investigate the difficulties that students, especially minority students, have in learning elementary algebra.

Population: Above and below average students enrolled in Algebra I.

Procedures: Clinical interviews employing the "think-aloud" techniques will be used to investigate students' internal thought processes as they work to solve standard textbook problems and nonstandard tasks developed for the study. Protocol data will be analyzed in an effort to identify patterns across problems and across students.

The analysis of students' learning will be conducted from the dual perspectives of mathematical content and psychological processes.

Expected Results: Alternative approaches to the teaching of elementary algebra will be suggested.

References

Meyer, Ruth Ann. "Intellectual Abilities that Discriminate Good and Poor Problem Solvers", in Journal for Research in Mathematics Education, Vol. 12, No. 2, March 1981. pp. 156-159.